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New records of noteworthy gasteroid fungi from Pakistan

N. Yousaf*, A.R. Niazi & A.N. Khalid

Department of Botany, University of the Punjab, Quaid-e-Azam Campus, Lahore, 54590, Pakistan
* Correspondence to: *nousheenyousaf@gmail.com*

Abstract — Gasteroid fungi were collected during the course of fieldwork in Pakistan. Here, we report on two species, *Bovistella japonica* and *Lycoperdon excipuliforme*, from the Himalayan moist temperate forest of the Khyber Pakhtunkhwa Province, each a new record for the country. *Phellorinia herculeana* represents a new record from Cholistan Desert of the Punjab Province. For each taxon reported, detailed macro- and microscopic descriptions are presented.

Key words — Biomes, Nathia gali, taxonomy

Introduction

The wide range of habitats in Pakistan that extends from coastal regions along the Arabian Sea to arid scrubland in the Punjab region and to the high altitude forests and tundra of the Himalayas supports a rich diversity of fungi. One group, the gasteroid fungi, has been documented from the nation in several publications (Long & Ahmad 1947, Ahmad 1952, Yoshimi & Hagiwara 1992, Khalid & Iqbal 1996, Ahmad et al. 1997, Sultan et al. 2001, Razzaq & Shahzad 2004, 2007, Iqbal et al. 2006, Sultana et al. 2007, Moreno et al. 2009). In total, 112 species representing approximately 30 genera have been reported from Pakistan. Although a considerable number of taxa are known, it is likely that the present accounting of Pakistani gasteroid fungi is far from complete, as a large portion of the country has been sampled only in a cursory manner, if at all.

In this study, we collected gasteroid fungi in two different biomes of Pakistan — the moist temperate forest of the Himalayas and scrubland of the Cholistan Desert. The Himalayan moist temperate forest extends from the Murree Hills of the Ayubia National Park to the Swat Valley (Khyber Pakhtunkhwa province), along the outer range of the Himalayas at an altitude of around 1850–2500 m (Ahmad et al. 2006). The Cholistan Desert, which covers a 26,000 km^2 area

in southwest Punjab province, is among the hottest and driest regions in the country (Akbar et al. 1996).

Here we report on three gasteroid species from Pakistan: *Bovistella japonica* and *Lycoperdon excipuliforme* were collected in the Himalayan moist temperate forest and represent new records for the country, while *Phellorinia herculeana* (previously reported from Pakistan as *P. inquinans*) represents a new record for the Cholistan Desert.

Materials & methods

Observations of microscopic characters (e.g., spore dimensions, eucapillitium, peridial hyphae) were made under a light microscope (at 1000× magnification) on material mounted in lactophenol and 5% KOH medium. Glebal color and macroscopic peridial features were observed using Meiji stereomicroscope, and illustrations were made with the help of a camera lucida.

The specimens have been deposited in gasteroid fungal collection of LAH Herbarium, Department of Botany, University of the Punjab, Lahore, Pakistan.

Taxonomy

Bovistella japonica Lloyd, Mycol. Writ. 2: 281 (1906) Fig. 1

Gasterocarp 55–85 mm diam. × 85 mm high, globose to subglobose, white when young, turning reddish brown with age. Sterile Base well developed, up to 30 mm high, spongy, chambered, basally attached to the substratum by well developed, thick mycelial strand, having white, branched rhizomorphs heavily encrusted with soil particles; ostiole lacking; dehiscence irregular, fruiting body breaking apart apically. Peridium < 1mm thick. Exoperidium white when young, becoming dull brown with age, thin, formed of granular matter which covers the endoperidium, persistent. Endoperidium entirely covered by exoperidium even in older specimen, light brown, thin, papery. Gleba brown, cottony, compact.

Basidiospores subglobose to ovoid, 4.0–5.5 × 3.8–4.7 µm, hyaline to greenish in KOH, pedicellate, pedicels short to very long, up to 19 µm long. Capillitium *Bovista* type, well developed, separate units having a thick main axis (≤ 20 µm diam.), thick walled (walls ≤ 2.85 µm), branches originating from the main axis, 1.2–6.0 µm diam. (walls ≤ 1.0 µm), with attenuate tips. Exoperidium composed of subglobose to irregular sphaerocysts. Endoperidium composed of hyaline, unbranched, and aseptate hyphae. Sterile Base composed of pigmented, thick walled, branched, and aseptate hyphae.

Material examined: **PAKISTAN**: **Khyber Pakhtun Khwa**, Nathia Gali, ca. 2500m (8205 ft) a.s.l., solitary, on ground, under *Pinus wallichiana* A.B. Jacks., in Himalayan moist temperate forest, 13 Sep. 2006, N. Yousaf NYG208 (LAH 130906).

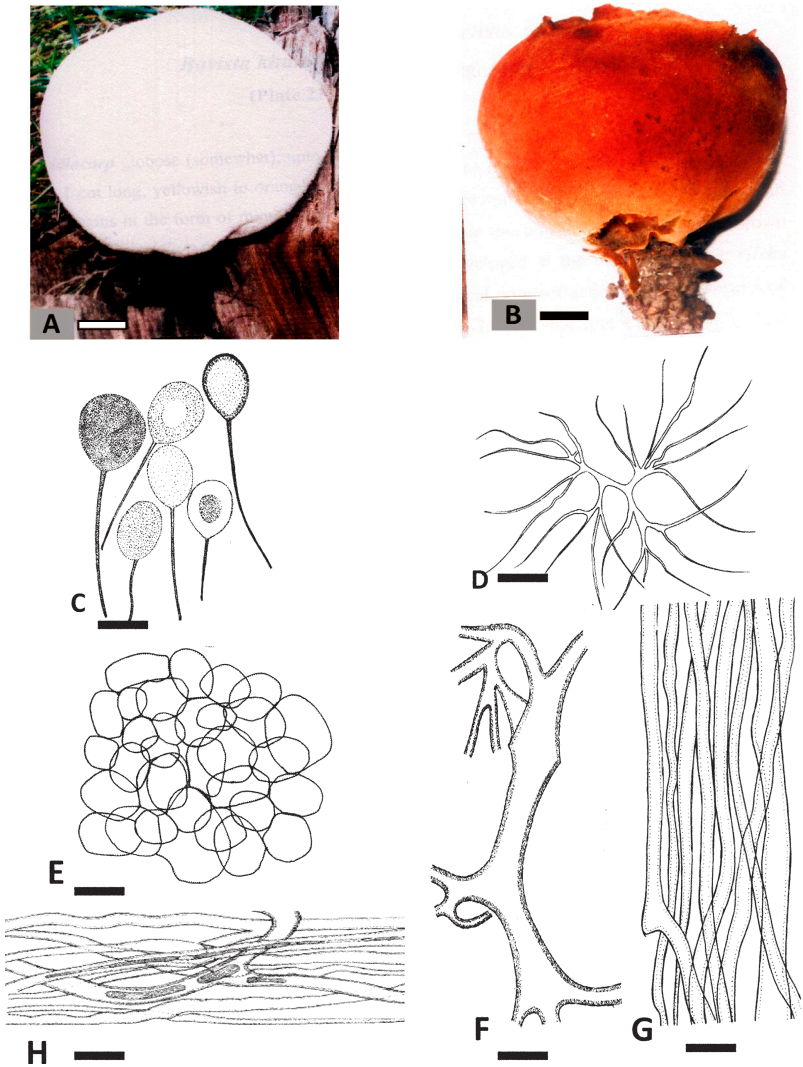

Fig. 1: *Bovistella japonica*. A. Young gasterocarp. B. Mature gasterocarp. C. Pedicellate basidiospores. D. Typical *Bovista* type capillitial units. E. Exoperidial elements (sphaerocysts). F. Thick, main axis of capillitial threads. G. Aseptate endoperidial hyphae. H. Hyphae of sterile base. Scale bars: A, B = 1.5 cm; C = 2.5 µm; D = 60 µm; E = 3 µm; F = 20 µm; G, H = 10 µm.

Comments: *Bovistella* was first proposed by Morgan in 1892, and the genus is distributed worldwide. *Bovistella japonica* is characterized by the presence

of short, separate capillitial units, pedicellate spores, and sterile base. The combination of *Bovista*-like capillitial units and *Lycoperdon*-like sterile base places the species in the intermediate genus, *Bovistella,* along with *B. ohiensis* (Ellis & Morgan) Morgan, *B. radicata* (Durieu & Mont.) Pat., *B. lycoperdoides* (Schwein.) Lloyd, *B. paludosa* (Lév.) Pat., and *B. ammophila* (Lév.) Lloyd. Among these taxa, *B. japonica* is more closely allied with *B. ohiensis* and *B. paludosa*, which also share the same general spore dimensions (~4–5 µm). *Bovistella japonica* can be distinguished by its more compact sterile base. This species is a new addition to the mycoflora of Pakistan.

Lycoperdon excipuliforme (Scop.) Pers., Syn. meth. fung.: 143 (1801) Fig. 2

Gasterocarp elliptical to turbinate, 30–50 mm diam. × 50 mm high; spore case broad, globose to subglobose; ostiole present, irregular. Sterile Base present, and forming a well-developed pseudostipe, attached to the substrata by well developed rhizomorphs, these white, branched, thick, and heavily encrusted with soil particles, and woody debris. Peridium layered, thickness ≤ 1 mm. Exoperidium dull brown, fragile, in the form of granules which later slough off. Endoperidium dull, golden brown, papery. Gleba dark brown, pulverulent.

Basidiospores globose to subglobose, dark brown, 5.3–6.7 µm diam. (4.4–5.5 µm excluding ornamentation), verrucose (verrucae ≤ 1 µm), numerous sterigmal remnants present in mounts, these up to 35.6 µm long. Capillitium *Lycoperdon*-type, capillitial threads 1.14–6.8 µm diam., branched, (dichotomous when occurring), thick-walled (walls ≤ 2 µm), sub undulated to undulate, aseptate, having slit-like pores, with attenuate tips. Paracapillitium absent. Exoperidium composed of subglobose sphaerocysts. Endoperidium composed of unbranched, septate hyphae.

Material examined: **PAKISTAN**: **Khyber Pakhtun Khwa**, Nathia Gali, ca. 2500m (8205 ft) a.s.l., solitary, on ground, under bamboo tree, in Himalayan moist temperate forests, 26 Aug. 2006, N. Yousaf NYG209 (LAH 268006).

Comments: Commonly called the "pestle puffball," *L. excipuliforme* usually fruits in groups from summer to autumn in coniferous and deciduous woodlands (Jordan 2006). It is characterized by large basidiomes consisting of an upper spore case and long pseudostipe and by the presence of slit-like pores in its capillitial threads. *Lycoperdon perlatum* Pers., which also develops the same reticulate pattern over the endoperidial surface as the larger verrucae slough off, differs in its smaller stature and the absence of a well-developed elongated pseudostipe. *Lycoperdon excipuliforme* is new to the mycoflora of Pakistan.

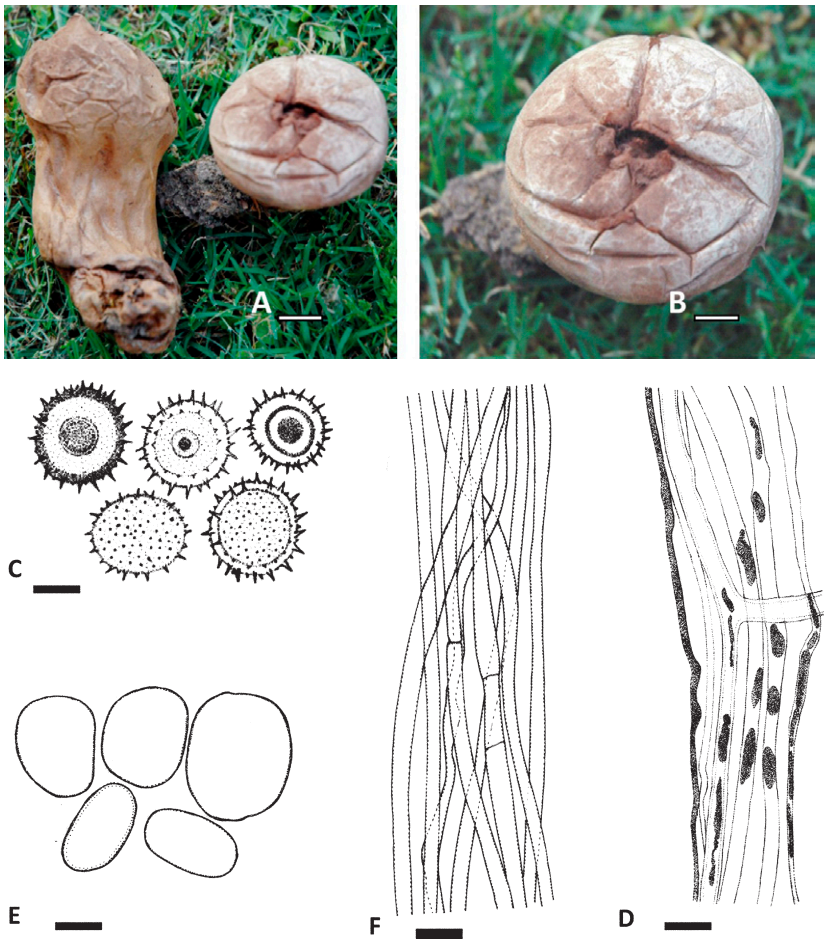

Fig. 2: *Lycoperdon excipuliforme.* A. Gasterocarps. B. Ostiole (arrow). C. Verrucose basidiospores. D. Capillitial threads. E. Exoperidial elements (sphaerocysts). F. Endoperidial hyphae. Scale Bars: A, B = 0.8 cm; C = 2.5 µm; D, F = 10 µm; E = 3 µm.

Phellorinia herculeana (Pers.) Kreisel, Česká Mykol. 15: 196 (1961) Fig. 3

= *Phellorinia inquinans* Berk., London J. Bot. 2: 521 (1843)

Gasterocarp consisting of spore case, stipe, and bulbous base, ≤ 85 mm tall; spore case ≤ 50 mm diam. × 35 mm high, basal portion encrusted with soil particles; dehiscing as apical portions wear away to expose the powdery spore mass. Stipe woody, continuous with spore case, not uniform, having a wide,

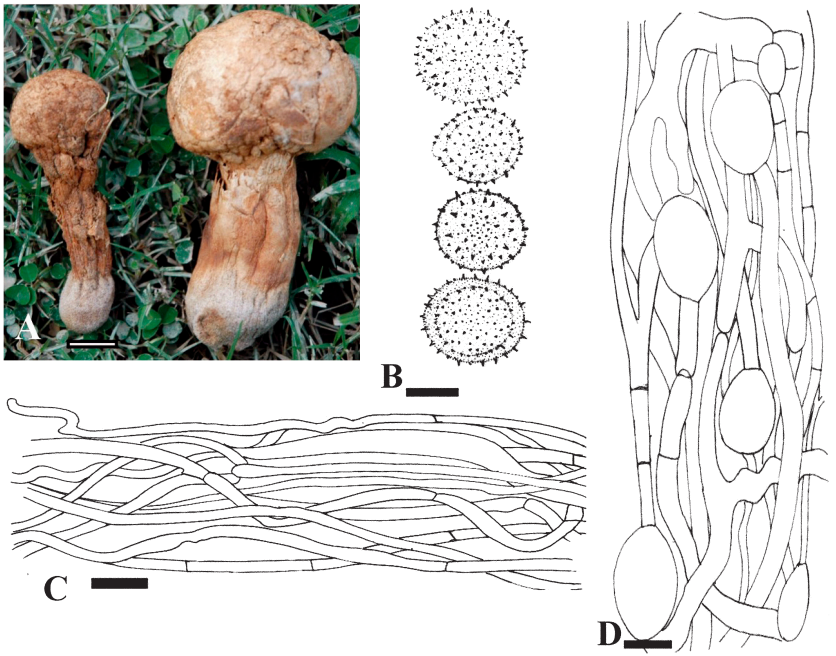

Fig. 3: *Phellorinia herculeana*. A. Gasterocarps. B. Verrucose basidiospores. C. Endoperdial hyphae. D. Exoperidial hyphae with globular elements. Scale Bars: A = 1.2 cm; B = 3 µm; C, D = 10 µm.

bulbous base, and tapering toward the apex, with parallel, broad ridges and furrows running from apex to base, and permanent scales scatter intermittently; rhizomorphs not observed. Exoperidium off-white when immature, pale yellowish to brown with age, thick, entirely covered with hard scales of variable sizes. Endoperidium continuous with stipe, pale yellow. Gleba pulverulent, brown.

Basidiospores globose to subglobose, apedicellate, hyaline, 4.5–8.0 µm diam., verrucose (verrucae < 1 µm long). Capillitium hyaline, rarely present in mounts. Exoperidium composed of branched, hyaline hyphae, with inflated, globose elements at their tips. Endoperidium composed of thin, hyaline, branching, septate hyphae.

Material examined: **PAKISTAN**: **Punjab**, Bahawalpur, Rahim Yar Khan, ca. 115 m (380 ft) a.s.l., Cholistan Desert, solitary, on ground, 29 Sep. 2006, N. Yousaf NYG210 (LAH 290900).

Comments: *Phellorinia* was erected by Berkeley in 1843 with *P. inquinans* Berk. as the type species. It is a monotypic genus that has been reported from

different regions of Pakistan by Ahmad (1952). *Phellorinia herculeana* is widely distributed across arid to semi-arid regions of all continents, including countries such as Australia (Fuhrer 2005, Williams & Woinarski 1997), Pakistan (Ahmad 1952, Ahmad et al. 1997), Spain, and Yemen (Kreisel & Fatimi 2004).

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Literature cited

Ahmad S. 1952. Gasteromycetes of West Pakistan. Punjab University Press. Lahore.

Ahmad S, Iqbal SH, Khalid AN. 1997. Fungi of Pakistan. Sultan Ahmad Mycological Society of Pakistan, Lahore.

Ahmad M, Husain T, Sheikh AH, Hussain SS, Siddiqui MF. 2006. Phytosociolgy and structure of Himalayan Forests from different climatic zones of Pakistan. Pak. J. Bot. 38(2): 361–383.

Akbar G, Khan TN, Arshad M. 1996. Cholistan desert, Pakistan. Rangelands 18(4): 124–128.

Fuhrer B. 2005. A field guide to Australian fungi. Blooming Books Pvt. Ltd. Science. 360 p.

Iqbal SH, Kasuya T, Khalid AN, Niazi AR. 2006. *Lysurus pakistanicus*, a new species of *Phallales* from Pakistan. Mycotaxon 98: 163–168.

Jordan P. 2006. Field guide. Edible mushrooms of Britian and Europe. New Holand Publishers (UK) Ltd. London.

Khalid AN, Iqbal SH. 1996. New Gasteromycetes from Pakistan. Sultania 1(2): 97–102.

Kreisel H, Fatimi MA. 2004. *Basidiomycetes* and larger *Ascomycetes* from Yemen. Feddes Repertorium 115(7–8): 547–561. http://dx.doi.org/10.1002/fedr.200411053.

Long WH, Ahmad S. 1947. The genus *Tylostoma* in India. Farlowia 3(2): 225–267.

Moreno G, Khalid AN, Alvarado P. 2009. A new species of *Phallus* from Pakistan. Mycotaxon 108: 457–462. http://dx.doi.org/10.5248/108.457.

Razzaq A, Shahzad S. 2004. *Pisolithus tinctorius*, a new record from Pakistan. Pak. J. Bot. 36(2): 449–451.

Razzaq A, Shahzad S. 2007. *Geastrum sessile* and G. *vulgatum*, new records from Pakistan. Pak. J. Bot. 39(6): 2193–2194.

Sultan A, Nazir K, Ayub N. 2001. Some common species of fleshy macromycetes (*Discomycetes*, *Gasteromycetes* and *Agaricales*) from Margalla hills national park and adjacent areas. Pak. J. Bot. 33(special issue): 709–721.

Sultana K, Gul M, Firdous SS, Asghar R. 2007. Hymenomycetes from Multan District. Pak. J. Bot. 39(2): 651–657.

Williams JE, Woinarski J. 1997. Eucalypt ecology: individuals to ecosystems. Cambridge University Press. United Kingdom.

Yoshimi S, Hagiwara H. 1992. Gasteroid fungi from Pakistan. 165–184, in: T Nakaike, S Malik [eds]. Cryptogamic Flora of Pakistan, Vol. I. National Science Museum Tokyo.